

# M-Series Printed-Wiring Board Specification

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**ABSTRACT:** This specification defines the requirements for M-series printed-wiring boards.

**APPLICABILITY:** This specification is mandatory for all suppliers of M-series printed-wiring boards.

**STATUS:** APPROVED 04-Oct-1991; use VTX SMC for current status.

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APPROVAL: This document has been reviewed and approved for use throughout Digital Equipment Corporation.

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## 1 INTRODUCTION

This document specifies the requirements for a rigid 6-layer printed-wiring board with plated-through holes.

If there is a conflict between the text of this specification and any other referenced document, this specification will take precedence.

## 2 REQUIREMENTS

The requirements of all sections of *DEC STD 176-0 Printed-Wiring Board Acceptance Criteria* and all supplements are incorporated in this document by reference. This specification is in addition to, not a replacement for, the requirements of DEC STD 176-0 and supplements.

### 2.1 GENERAL REQUIREMENTS

Printed-wiring boards delivered under this specification shall meet the detailed requirements of this section, the master drawing, and DEC STD 176-0. Any anomalies or defects found on coupons or sample boards shall be noted, and proper corrective action shall be initiated.

### 2.2 QUALIFICATION

Qualification is not required for printed-wiring boards delivered under this specification.

### 2.3 TERMS AND DEFINITIONS

The terms and definitions used herein shall be as specified in ANSI/IPC-T-50B, *Terms and Definitions for Interconnecting and Packaging Electronic Circuits*.

## 3 MATERIALS

### 3.1 METAL CLAD LAMINATES

Metal clad laminates shall be of the composition generally known as FR-4 and acceptable for use per DEC STD 176-0.

### 3.2 BONDING MATERIAL

Bonding material shall be of the composition generally known as FR-4 and acceptable for use per DEC STD 176-0.

### 3.3 SOLDER COATING

Solder used for coating shall be in accordance with QQ-S-571 Military Standard type Sn 60, Sn 62, or Sn 63.

### 3.4 SOLDERMASK

Soldermask shall be a polymer coating conforming to ANSI/IPC-SM-840A, *Qualification and Performance of Permanent Polymer Coating (Solder Mask) for Printed Boards*.

### 3.5 MARKING INK

Marking ink shall be permanent, non-nutrient, and non-conductive polymer ink.

### 3.6 VISUAL REQUIREMENTS

The visual requirements of DEC STD 176-0 shall apply.

### 3.7 WORKMANSHIP

The workmanship requirements of DEC STD 176-0 shall apply.

## 4 DIMENSIONAL

### 4.1 OVERALL DIMENSIONS

The overall dimensions shall be per the master drawing.

### 4.2 LAYUP

The layer configuration and applicable dimensions used shall be per Table 1. Alternate layups must be specifically approved by the procuring organization within Digital.

**Table 1: Layup**

| Layer Type | Layer Name                    | Copper Weight |
|------------|-------------------------------|---------------|
| Signal     | L1<br>FR-4 0.013 ± 0.013 inch | 1 oz          |
| Plane      | L2<br>FR-4 0.010 ± 0.001 inch | 1 oz          |
| Signal     | L3<br>FR-4 0.010 ± 0.001 inch | 1 oz          |
| Signal     | L4<br>FR-4 0.010 ± 0.001 inch | 1 oz          |
| Plane      | L5<br>FR-4 0.013 ± 0.013 inch | 1 oz          |
| Signal     | L6                            | 1 oz          |

- Weight of copper refers to the minimum finished copper thickness. One ounce copper is to be 0.001 inch minimum finished thickness.
- Suggested dielectric constant is  $4.1 \pm 0.4$  measured at 1 MHz.
- Material thickness tolerance is  $\pm 10\%$  on each layer.

- Total PWB thickness is  $0.062 \pm 0.007$  inch

### 4.3 HOLE AND VIA SIZES

Finished hole and via sizes shall be according to Table 2.

**Table 2: Hole and Via Sizes**

| Feature | PTH Diameter       | Pad Diameter | Clearance Diameter |
|---------|--------------------|--------------|--------------------|
| Via     | 0.000 - 0.020 inch | 0.040 inch   | 0.050 inch         |
| Hole    | 0.037 - 0.042 inch | 0.070 inch   | 0.080 inch         |

- There is no minimum via PTH diameter; the hole can be plated shut.
- Number of lines between holes = 2 (0.100 inch grid)
- Number of lines between vias = 2 (0.100 inch grid)
- Number of lines between via and hole = 2 (0.100 inch grid)

### 4.4 SIGNAL LINE WIDTH

The minimum line width for all lines shall be 0.006 inch. Suggested line width to achieve 75-ohm electrical impedance on all signal layers, and 0.0060 inch on layers three and four are listed in Table 3.

**Table 3: Signal Line Width**

| Layer | 75-Ohm Line Width |
|-------|-------------------|
| L1    | 0.0060 inch       |
| L3    | 0.0060 inch       |
| L4    | 0.0060 inch       |
| L6    | 0.0060 inch       |

### 4.5 CONDUCTOR THICKNESS

All conductors shall be 0.001 inch thick minimum.

### 4.6 CONDUCTOR PATTERN

The conductor pattern shall be as specified on the master drawing.

### 4.7 CONDUCTOR SPACING

Minimum conductor spacing shall be 0.005 inch per DEC STD 176-0 on all layers.

#### 4.8 ANNULAR RING

There shall be no annular ring for pads with plated-through holes per DEC STD 176-0. The outer diameter of the hole may be tangent to the outer diameter of the pad. In the region of pad expansion in the direction of the signal line, there shall be 0.002 inch minimum annular ring according to DEC STD 176-0.

#### 4.9 SOLDERMASK

Soldermask shall be applied to both sides of the PWB, according to DEC STD 176-0.

### 5 ELECTRICAL REQUIREMENTS

#### 5.1 CHARACTERISTIC IMPEDANCE

Characteristic impedance of lines designated as controlled impedance on the master drawing shall be  $75 \pm 7$  ohms (line to ground). Impedance is measured via a test coupon that is part of the manufacturing panel. Use of a properly calibrated TDR to measure the impedance of the test coupon is required only when controlled impedance is specified on the master drawing.

#### 5.2 DIELECTRIC WITHSTANDING VOLTAGE

Printed-wiring boards delivered under this specification shall be tested for dielectric withstanding voltage per DEC STD 176-0 using the procedure of MIL STD 202E *Test Methods*, except that the voltage shall be 1000 volts minimum for 10 seconds. This test shall apply between planes only. There shall be no evidence of arcing or breakdown. Boards may be tested prior to separation from the panel.

#### 5.3 CIRCUIT CONTINUITY

Printed-wiring boards delivered under this specification shall be tested for circuit continuity per DEC STD 176-0.

#### 5.4 CIRCUIT SHORTS

Printed-wiring boards delivered under this specification shall be tested for circuit shorts per DEC STD 176-0.

## APPENDIX A REFERENCED DOCUMENTS

### A.1 EL-Class Digital Documents

| EL-Class Number | Document Title                                                |
|-----------------|---------------------------------------------------------------|
| EL-00176-00     | <i>DEC STD 176-0 Printed-Wiring Board Acceptance Criteria</i> |

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

### A.2 Other Documents

| Document Number  | Document Title                                                                                     |
|------------------|----------------------------------------------------------------------------------------------------|
| ANSI/IPC-SM-840A | <i>Qualification and Performance of Permanent Polymer Coating (Solder Mask) for Printed Boards</i> |
| ANSI/IPC-T-50B   | <i>Terms and Definitions for Interconnecting and Packaging Electronic Circuits</i>                 |
| MIL STD 202E     | <i>Test Methods</i>                                                                                |
| QQ-S-571         | <i>Military Standard</i>                                                                           |

### A.3 Ordering Information

Following are the sources for IPC documents not available from Standards and Methods Control.

- ANSI, IEC, and ISO Documents  
American National Standards Institute (ANSI),  
1430 Broadway, New York, NY 10018,  
Telephone (212) 354-3300 x479  
or
- The Institute for Interconnecting and Packaging Electronic Circuits  
3451 Church Street  
Evanston, IL 60203  
Telephone (312) 677-2850



## APPENDIX B RELATED DOCUMENTS

### B.1 EL-Class Digital Documents

| EL-Class Number | Document Title                                                                            |
|-----------------|-------------------------------------------------------------------------------------------|
| EL-00030-00     | <i>DEC STD 030-0 Module Manufacturing Standard - Introduction and General Information</i> |

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

### B.2 Other Digital Documents

| Document Number   | Document Title                                                              |
|-------------------|-----------------------------------------------------------------------------|
| A-PS-1400000-GS-0 | <i>PCB Board Requirements and Materials, General Purchase Specification</i> |

### B.3 Ordering Information

Following are the sources for documents not available from Standards and Methods Control.

- Federal Standards, Military Standards, Naval Publications, and Forms Center:  
5801 Tabor Avenue  
Philadelphia, PA 19120  
Telephone (215) 697-3321
- Central Specification Control Systems,  
NRO-5/M2, any Microfilm Reference File, or the SPOC System



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